Space Weather Technical Forecast

Issued on Thursday, 14 March 2024 at 12:53 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-flares (R1/R2 Radio Blackouts) day 1.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Moderate, with peak flare of M1.0 observed at 14/0604 UTC from AR3599. There are seven numbered regions on the visible disc. AR3599 remains the largest and most complex group on the disc, although this is now difficult to analyse as is is in the process of transiting around the southwest limb and therefore its previous classification is conserved. This region did contain a delta spot in its leading portion. AR3606 and AR3607 both show a decaying and simplifying trend. The remaining spots are all small and simple.

There were no Earth directed CMEs observed in the past 24 hours, though the analysis of a large filament eruption in the north near centre disk is ongoing.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at L1 by ACE showed a slow rising trend, but remained slightly elevated throughout, rising from around 400 km/s to 470 km/s. The solar wind density was generally below average. The Interplanetary Magnetic Field (IMF), Bt, was on a gradual rising trend from weak to an average of moderate, rising from around 5nT to 8nT, with a peak of 9nT observed at 14/0505 UTC. The north south component, Bz, showed a similar trend varying between +8 and -6nT, becoming mostly positive with time, with the only sustained period of -Bz observed early in the period. The phi angle was largely positive (away from the Sun). Geomagnetic activity was Quiet (Kp 1-2) with an Unsettled (Kp 3) interval between 14/1800-2100 UTC.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux remained at background throughout.

High energy electron flux (greater than 2MeV) observed at GOES16 were mostly background to moderate, with a peak of 226pfu at 13/1635UTC. The observed 24-hour fluence showed a declining trend, with the 24-hour integrated fluence value at 14/0000 UTC being 6.23e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a Chance of M-class flares, most likely from AR3599 on day 1 (14 Mar), this reducing to a slight chance from day 2 (15 Mar) onward, as the aforementioned spot rotates completely around the southwestern limb.

Solar Wind / Geomagnetic Activity: A single CME remains in the forecast, that of the M7.4 on 10 March, though is now assessed as a likely miss. There remains a diminishing chance of a slight interaction with Earth later on 14 Mar, though this is now very low confidence. A weak connection from CH09/+ is assessed as ongoing, with minimal affect on geomagnetic activity. A small negative polarity coronal hole, CH10/- may come into effect later on days 3 and 4 (16-17 Mar).

Mostly Quiet to Unsettled conditions are therefore expected over the next few days, with a slight

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

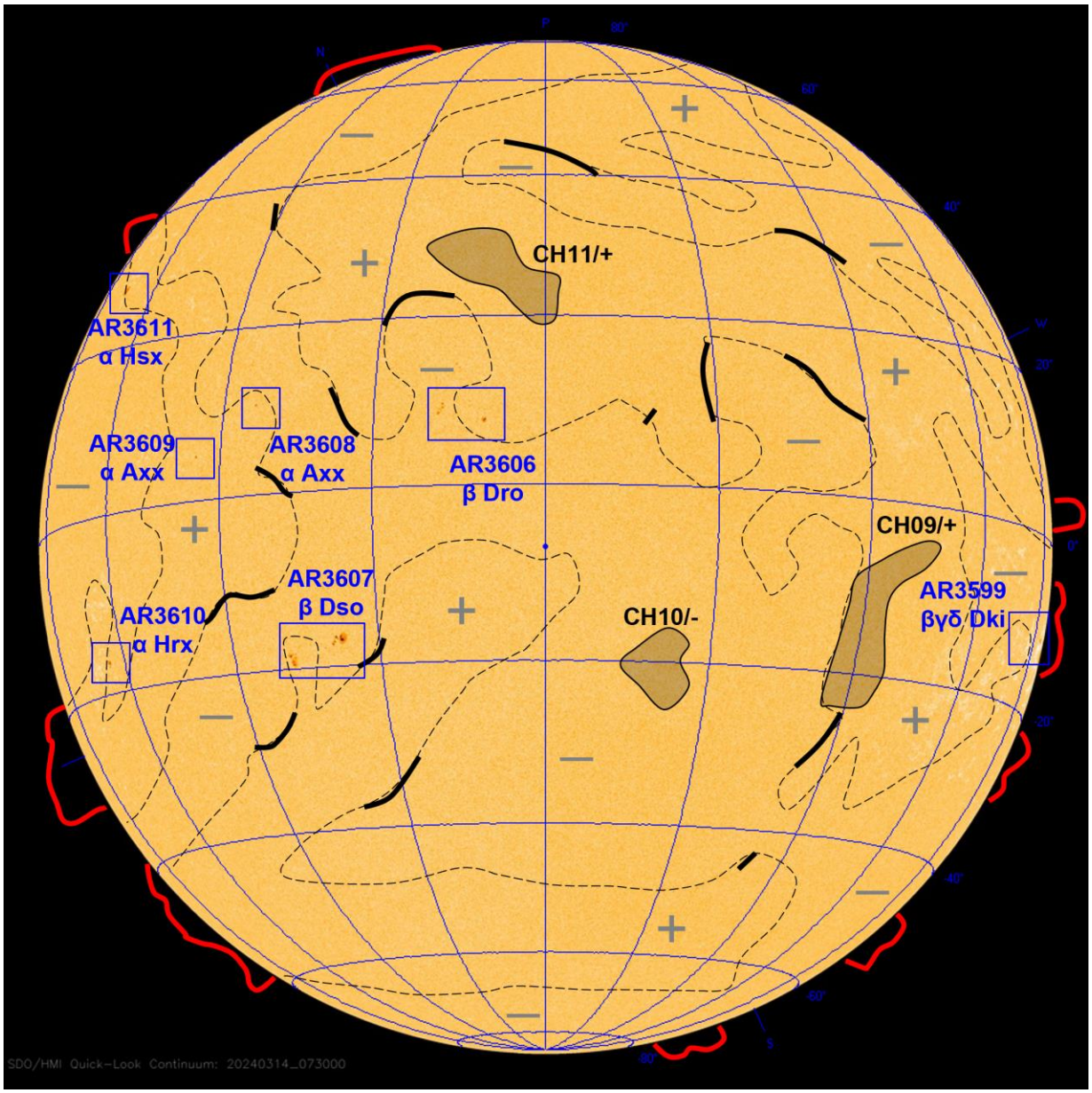
© Crown Copyright 2024. All Rights Reserved.

chance of Active/G1 Minor Geomagnetic Storm on day 1 (14 Mar) should the 10 Mar CME materialise.

Energetic Particles / Solar Radiation: High energy electron flux (greater than 2MeV) has shown a decreasing trend, with diurnal Moderate levels falling back to background at minima. This trend is expected to continue with no considerable enhancements expected.

24-hr integrated fluence is likely to remain below the Active threshold throughout.

Figure 1. Solar Analysis Valid 14/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms:

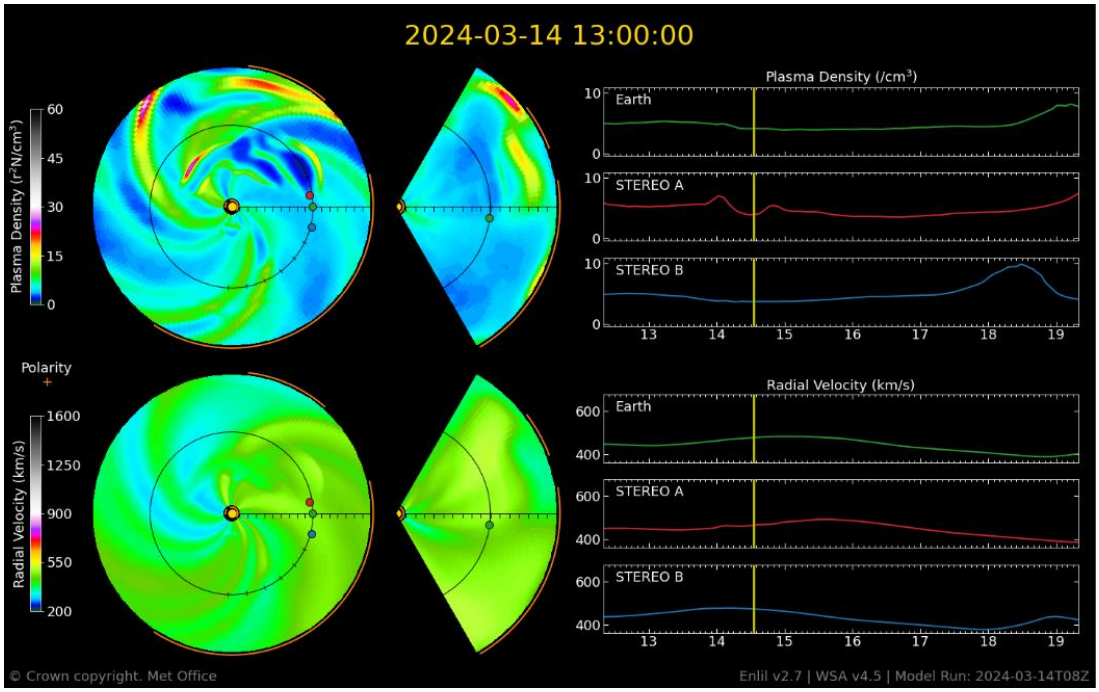
There is one CME in the forecast, the M7.4 CME of 10 March, this was expected to pass largely above and ahead of the track of the Earth in its orbit early on Day 1 (14 Mar), though is now assessed as a likely miss. There remains a diminishing chance of a slight interaction with Earth later on 14 Mar, though this is now very low confidence.

The fast wind aspect of the forecast is also of relatively low confidence, with none of the current cohort of coronal holes particularly well-formed or having strong links to previous rotations. A weak connection from CH09/+ is assessed as ongoing, with minimal affect on geomagnetic activity. A small negative polarity coronal hole, CH10/- may come into effect later on days 3 and 4 (16-17 Mar) but this is low confidence at this point.

Mostly Quiet to Unsettled conditions are therefore expected over the next few days, with a slight chance of Active/G1 Minor Geomagnetic Storm on day 1 (14 Mar) should the 10 Mar CME materialise.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC ENLIL



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

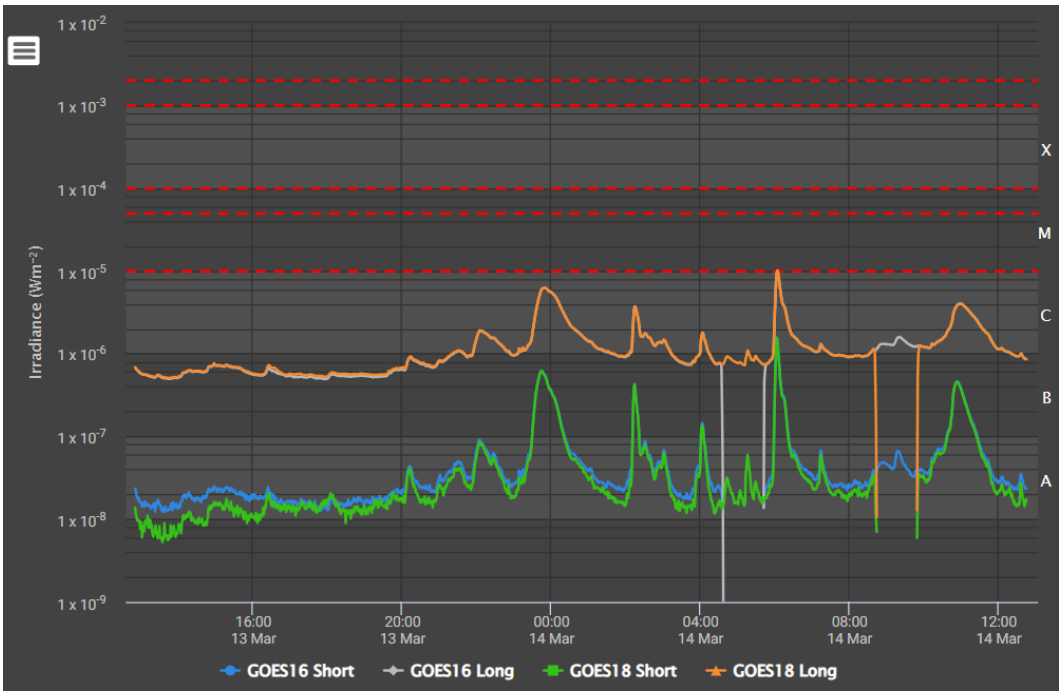
Radio Blackouts - X-Ray Flares:

There are seven numbered regions on the visible disc. AR3599 remains the largest and most complex group on the disc, although this is now difficult to analyse as is is in the process of transiting around the southwest limb and therefore its previous classification is conserved. This region did contain a delta spot in its leading portion. AR3606 and AR3607 both show a decaying and simplifying trend. The remaining spots are all small and simple.

The X-ray flare forecast for the coming days mainly comes from the AR3599 sunspot region, and its passage around the western limb which currently occurring. There remains a Chance of M-class flares on 14 Mar, mainly from this region, with a diminishing slight chance as it rotates completely around the limb. Ex-AR3590 is due to rotate around northeast limb toward the end of the forecast period, this spot was the source of several strong flares on previous rotation, therefore an increasing but still Slight Chance of moderate or strong flares is catered for on day 4 (17 Mar).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	20	10	20
Very Active	R3 to R5 X Class	No	5	1	1	5

Figure 3: 24 hour X-Ray trace



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

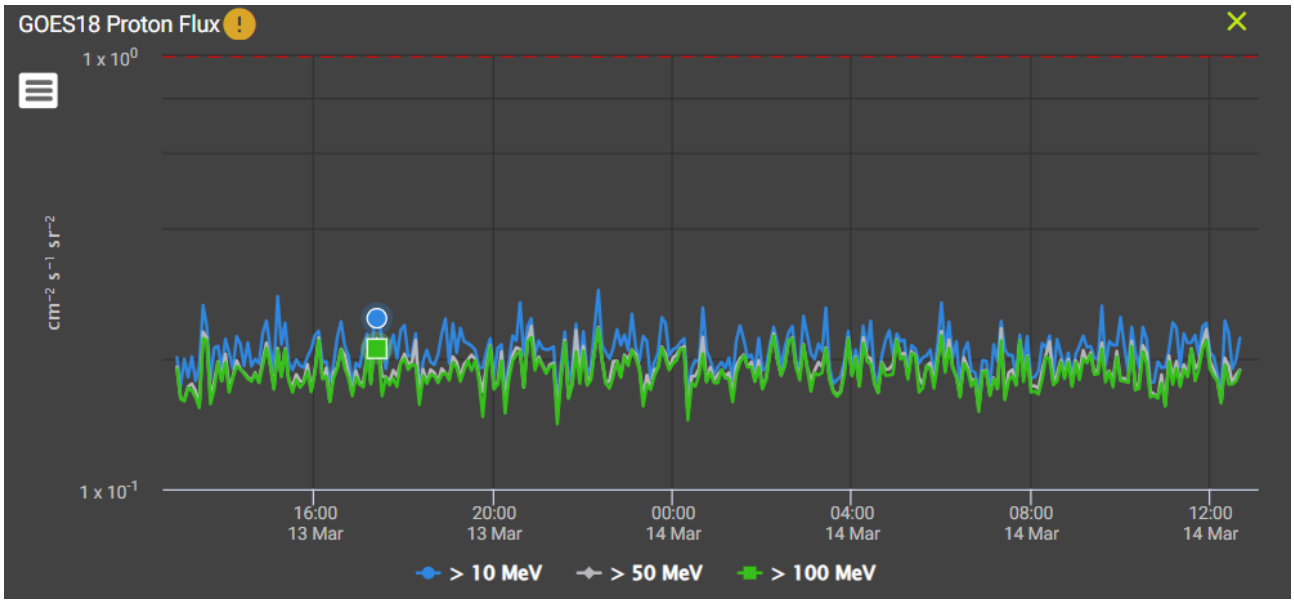
Solar Radiation Storms - (High Energy Protons):

GOES18 proton flux levels are very closely tied to developments in AR3599, with no other sunspot groups of note. This feature is rotating around the southwestern limb at present, therefore the Slight Chance of S1+ reduces further through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: 24 hour proton trace



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

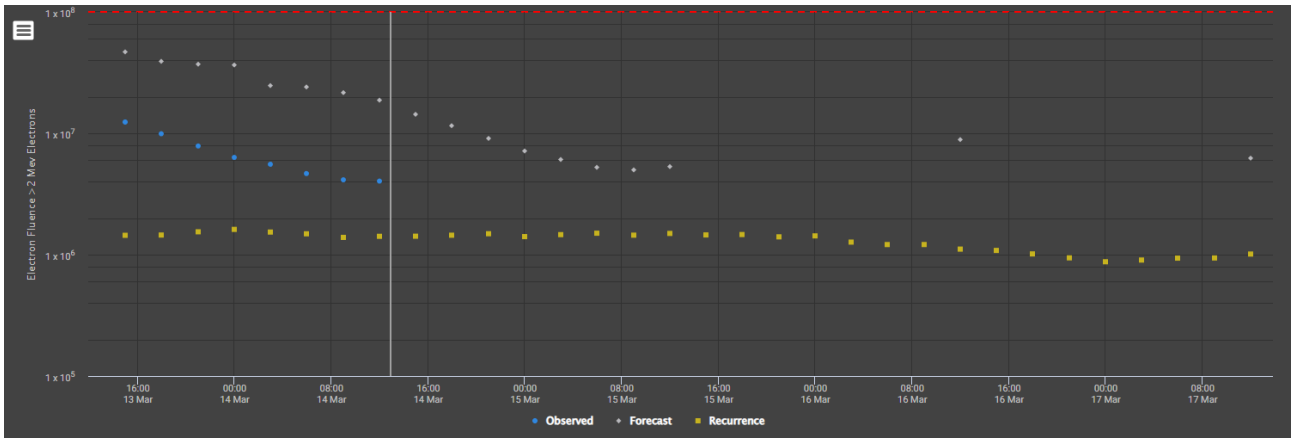
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has shown a decreasing trend, with diurnal Moderate levels falling back to background at minima. This trend is expected to continue with no considerable enhancements expected.

24-hr integrated fluence is likely to remain below the Active threshold throughout.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM fluence forecast/observations/recurrece



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.